MASTER GUARD
A Chloride Group Company

Secure Power Always

Series C from 10 to 60 kVA

UPS Catalogue

Important note!

The technical data enclosed is for general information. Please note the operating instructions and the references indicated on the products are for installation, operation and maintenance.

Product designations

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Person to contact

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Uninterruptible Power Supply Systems

UPS Catalogue • 2008

Series C from 10 to 60 kVA

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1. Scope

The following specification describes a continuous duty three phase, static, IGBT Uninterruptible Power System (UPS). The UPS shall automatically provide continuity of electrical power, within defined limits and without interruption, upon failure or degradation of the commercial AC source. The continuity of conditioned electric power shall be defined by the battery system for the autonomy time period; the battery system will be automatically recharged by the UPS upon restoration of the commercial AC source.

2. System Description

Series C is an intelligent double conversion UPS, as shown in Figure 1. The systems shall operate on a DSP-based IGBT inverter. Through Vector Control technology, the performance of the inverter shall be enhanced and shall be capable of providing reliable, high quality AC power. In order to increase system redundancy, an independent electronic static bypass shall be integrated into the UPS. By adding system components, such as parallel kits, safety and disconnecting devices, system bypass switches, as well as software and communications solutions, it shall be possible to set up elaborate systems ensuring the complete protection of the supplied loads.

2.1 The system

The UPS shall provide high quality AC power for electronic equipment loads and shall offer the following benefits:

- Increased power quality, for optimal and safe operation of loads.
- Full noise rejection, for complete load protection against upstream network disturbances
- Full compatibility with all types of loads, including heavily non-linear ones
- Power blackout protection in case of power outages
- Full battery care, to preserve the useful life of the battery system
- Transformer-less design, allowing reduced footprint and weight (galvanic isolation transformers are available as standard options)

The UPS shall automatically provide continuity of electrical power, within the defined limits and without interruption, upon failure or degradation of the commercial AC source. The length of the backup time, i.e. autonomy time in the event of network failure, shall be determined by the battery capacity.

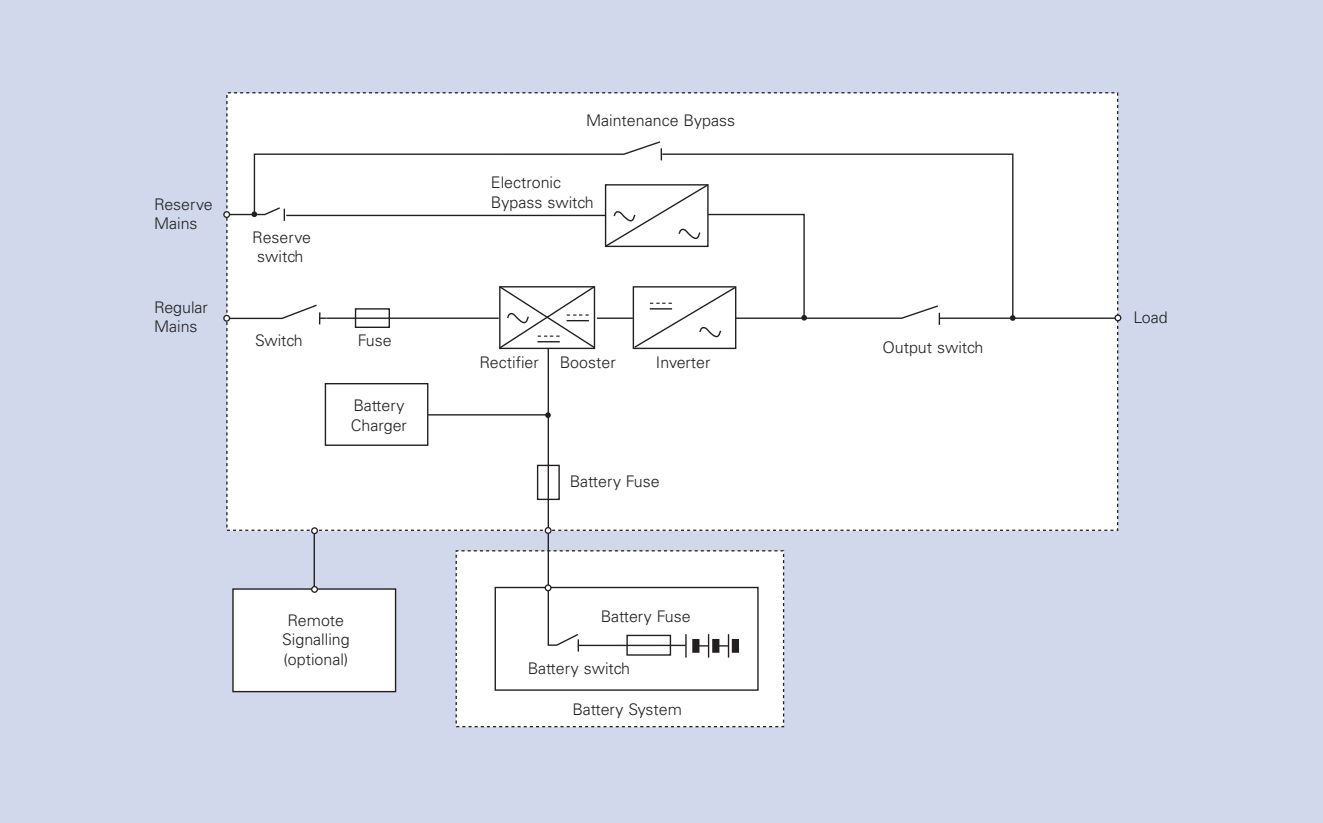


Figure 1. Series C single-line block diagram

2. System Description

2.2 Models Available

The Series C range shall include three phase input/output models as specified in the following table:

MODEL	Rating (kVA)	MODEL	Rating (kVA)
Series C/10	10	Series C/40	40
Series C/15	15	Series C/50	50
Series C/20	20	Series C/60	60
Series C/30	30		

3. General Requirements

3.1 Applied Standards

MASTERGUARD is certified by the British Standard Institution (BSI), as a company with a quality and environmental system in accordance with the ISO 9001 and ISO 14001. Series C shall carry the CE mark in accordance with the Safety and EMC Directives 2006/95 (superseding the 72/23 and successive amendments), 89/336, 92/31 and 93/68. Series C is designed and manufactured in accordance with the following international standards:

- IEC/EN 62040-1-1 General and safety requirements
- EN 50091-2 EMC requirements
- IEC/EN 62040-3 Performance and Operating requirements

3.2 Components and materials

All materials and parts contained within the UPS shall be new and in current production and, to ensure maximum reliability, they shall be used well within the parameters recommended by the supplier.

3.3 Neutral/Earth

Series C neutral output shall be electrically isolated from the UPS chassis. Series C shall not modify the neutral state. Therefore, the downstream distribution shall be of the same type as the input distribution whilst the upstream neutral is connected to the UPS.

Series C must be used in installations with grounded neutral; for further details please contact MASTERGUARD Technical Support (special versions may be used - see

4. Device Description

In this section the main functional blocks of Series C and operating modes of this UPS are described.

4.1 Functional blocks

The UPS shall consist of the following major functional blocks (refer also to Figure 1):

- AC/DC converter. The rectifier shall be capable of delivering the necessary power to the DC bus to drive the inverter, absorbing virtually only active power from the upstream network (Power Factor Correction)
- Battery Charger. This device shall be able to completely recharge the battery bank, by delivering DC power to the batteries with a very low voltage and residual current ripple
- Booster. This DC/DC converter will boost the rectifier/battery DC voltage, creating a split DC bus, which will allow the inverter to recreate the AC nominal voltage without the need for an output transformer
- DC/AC converter. The IGBT transformer-less inverter shall be controlled by a Digital Signal Processor (DSP), see section 4.3 for details
- Static bypass with separate input feeder. The electronic static switch on the reserve supply shall be capable of switching the load from the inverter line to the direct line, and vice-versa, with a Make Before Break (MBB) transition, either upon manual or automatic command (see section 4.4 for details)
- Manual maintenance bypass switch. This manual switch shall allow complete internal maintenance of the unit without interruptions to the load power supply
- Integrated batteries into the UPS cabinet (10 - 40 kVA range) for basic autonomies
- Matching battery cubicles for extended battery autonomies

4.2 Microprocessor diagnostics and control

Operation and control of the UPS shall be provided through the use of microprocessor controlled logic. Indications, measurements and alarms together with battery autonomy shall be shown on a back-illuminated graphical LCD display. The procedures for start up, shut down and manual transfer of the load to bypass and return from bypass shall be described by clear step-by-step actions, reported on the user manual and assisted through the LCD display.

Control of the power electronics modules will be optimised in order to provide:

- An optimum three-phase supply of the load
- Controlled charging of the battery
- Minimum phase effects upon the upstream supply network

4.2.1 Redundancy, preventative monitoring

In order to maximise the reliability of the system, the control unit shall monitor a wide number of operating parameters of the rectifier, inverter and battery. All the important operating parameters, such as temperature, frequency and voltage stability at the system output, as well as all the load parameters and internal system values shall be continuously monitored and controlled for irregularities. The system shall react automatically prior to a critical situation for the UPS or the load, in order to ensure the supply of the load even in the most critical situations.

4.2.2 Remote diagnosis and control

Using an advanced remote diagnosis and control system, it shall be possible to remotely monitor and control the UPS from a location such as a service centre in order to maintain the reliability of the system at optimal levels.

4. Device Description

4.3 Digital Vector Control System

By using digital signal processors (DSP), Series C shall implement the most advanced Digital Vector Control system. Special arithmetic algorithms shall be implemented to ensure quick and flexible processing of measuring data. As a result, controlled variables shall be rapidly generated and transferred to the IGBT drivers in PWM mode (Pulse Width Modulation). Thus, real time control of inverter electronics shall be possible. This results in advantages concerning the performance of power components. Advantages involved shall include:

- Improved short circuit behaviour, since the individual phases can be quickly and individually controlled
- Synchronism or phase angle precision between UPS output and reserve supply even in the event of a distorted mains voltage
- High flexibility and reliability in parallel operations. Furthermore, parallel blocks can be placed in different rooms

4.4 Intelligent Double Conversion operating modes

Series C adopts Intelligent Double Conversion technology which allows UPS to operate in double conversion or digital interactive mode according to the selected priority. The UPS will operate as follows:

4.4.1 Double Conversion Mode

4.4.1.1 Normal

The IGBT inverter continuously supplies the load. The rectifier derives power from the mains supply and converts it into DC power for the inverter. The AC/DC rectifier corrects the load power factor to a value of >0.95 and, for the 10 - 40 kVA range, also reduces the input current total harmonic distortion (THDI) to a value of less than 8% (at $P_{OUT} = P_{NOM}$). The battery charger automatically maintains the battery in a fully charged and optimum operational condition. The IGBT inverter is constantly synchronised to the direct input line, thus allowing load transfer from the inverter to the direct bypass line without any interruption in power to the load in the event of overload or inverter stop.

4.4.1.2 Overload

If the inverter stops, via operator intervention or due to an overload, the UPS automatically transfers to the direct line (if available) without interruption. When the overload ceases, return to the inverter is automatic. This enables Series C to handle the inrush current of the load without the need to over-size the UPS. The transfer to direct line is only allowed when voltage and frequency of the mains power supply are within limits. In the event of an overload with an unsuitable mains supply, Series C prevents the transfer and the inverter continues to supply the load for a period, depending on the degree of overload. Appropriate visual and audible alarms inform the user of the particular abnormal operating condition.

4.4.1.3 Emergency

If the mains supply has failed or is outside tolerance limits, the batteries are used to power the load. The user is alerted to the battery discharge through visual and audible alarms and the battery capacity is displayed on the graphical display. It is possible to extend the autonomy remaining by turning OFF non-essential loads. The warning indicator on Series C will display battery operation.

4.4.1.4 Return to normal conditions

When the mains power supply returns within tolerance limits, Series C resumes normal operation. The battery charger automatically recharges the battery to ensure maximum autonomy in the shortest possible timeframe.

4.4.1.5 Recharge

Even if batteries are completely discharged, the rectifier/charger shall automatically restart upon restoration of the commercial AC source and shall take over the inverter after a programmable delay. This shall be a fully automatic function and shall cause no interruption to the critical load.

4.4.2 Digital interactive mode

If priority has been set to digital interactive mode, intelligent double conversion technology shall allow Series C to continuously monitor the condition of the input supply to ensure maximum reliability for critical users.

On the basis of the analysis performed, it shall decide whether to supply the load through direct line or conditioned line. This operational mode, which allows significant energy savings by increasing overall UPS AC/AC efficiency, is primarily intended for general purpose ICT applications. However, it does not provide the same output power quality as when the UPS is operated in Double Conversion mode. Therefore, it shall be necessary to verify whether this mode is appropriate for special applications. Digital Interactive mode shall not be available for parallel systems.

4.4.2.1 Normal

The operating mode will depend on the quality of the mains during the recent past. If the line quality has remained within permitted tolerance levels, the direct line continuously supplies the critical AC load through the static switch. Control of the IGBT inverter constantly operates and is synchronised with the direct line. In the event of any deviation from the selected input power tolerance levels, this ensures that the load can be transferred to the conditioned line without any break in supply. If the direct line failure rate has reached outside permitted parameters, Series C shall supply the load from the conditioned line. The battery charger supplies the energy necessary to maintain the optimal charging level to the battery.

4.4.2.2 Inverter stop or overload

If the Inverter is stopped either by the operator or due to an overload, there is no transfer to the conditioned line and the load continues to be supplied by the direct line. Mains voltage and frequency values must remain within the specified tolerance limits. In the event of an overload lasting more than the maximum specified capacity, the load is transferred to the conditioned line, which will supply it for a specific time depending on the level of overload. In the event of an overload and an unsuitable mains supply, Series C transfers the load from the direct line to the conditioned line (assuming Series C was operating from direct line) and the inverter continues to supply the critical load for a time that depends on the degree of the overload and the UPS features. Visual and audible alarms alert the user to the problem.

4. Device Description

4.4.2.3 Emergency (the mains supply has failed or is outside tolerance limits)

If Series C supplies the load via direct line and the mains supply reaches outside the tolerance levels (adjustable by software), the load will be transferred from the direct line to the conditioned line. The load is powered from the mains via the rectifier and inverter, provided the input mains remains within its nominal tolerance. If the input mains is outside these limits, batteries are used to power the load via the inverter. The user is alerted to the battery discharge by visual and audible alarms and the autonomy remaining is displayed on the graphical display. At this time, it is possible to extend the autonomy remaining by turning off non-essential loads.

4.4.2.4 Return to normal conditions

When the mains supply returns to within tolerance limits, Series C continues to supply the load via the conditioned line for a period of time dependant upon the direct line failure rate (the conditioned line draws power from the mains not the battery). When the direct line has stabilised, Series C returns to normal operation. The battery charger automatically begins to recharge the battery. Consequently, maximum autonomy is guaranteed in the shortest possible time.

4.4.3 Maintenance bypass

If for any reason the UPS has to be taken out of service for maintenance or repair, the UPS shall be provided with an internal maintenance bypass switch which enables a load transfer to reserve supply with no interruption in power to the critical load. Bypass isolation shall be complete, all serviceable components such as fuses, power modules etc. shall be isolated.

4.4.4 Operation Without Battery

If the battery is taken out of service for maintenance, it shall be disconnected from the rectifier by means of battery switches provided in the UPS or in the external battery cabinet. During the maintenance, the UPS will continue to operate and meet the performance criteria specified, with the exception of back-up capability.

4.5 Backfeed protection (from November 2005)

This feature shall prevent any potential risk from electric shock on the UPS bypass input AC terminals in the event of failure of the bypass static switch SCR. The control circuit shall include a contact (available for the user) which activates an external isolating device, such as an electromechanical relay or a tripping coil, upon backfeed detection. The external isolating device is not included in the UPS, in compliance with IEC/EN 62040-1. The external isolating device shall be an air gap isolator, and shall be defined according to clause 5.1.4 of the previously cited standard.

5. Monitoring and Control Interfaces

5.1 General

The UPS shall incorporate the necessary controls, instruments and indicators to allow the operator to monitor the system status and performance, as well as take any appropriate action. Furthermore, interfaces shall be available which allow extended monitoring and control, as well as service functions.

5.2 LCD display and control panel

The control panel of Series C includes a back-lit Liquid Crystal Display (LCD with 8 lines x 12 characters, which can display graphic diagrams and symbols) for complete UPS monitoring and control. Complete access to all LCD menus is possible through navigation push buttons located below the screen. This navigation group includes two buttons - "up" and "down" - for menu scrolling and two software-assigned push buttons: the function linked to these two buttons is displayed on the lower right and lower left corners of the LCD during navigation.

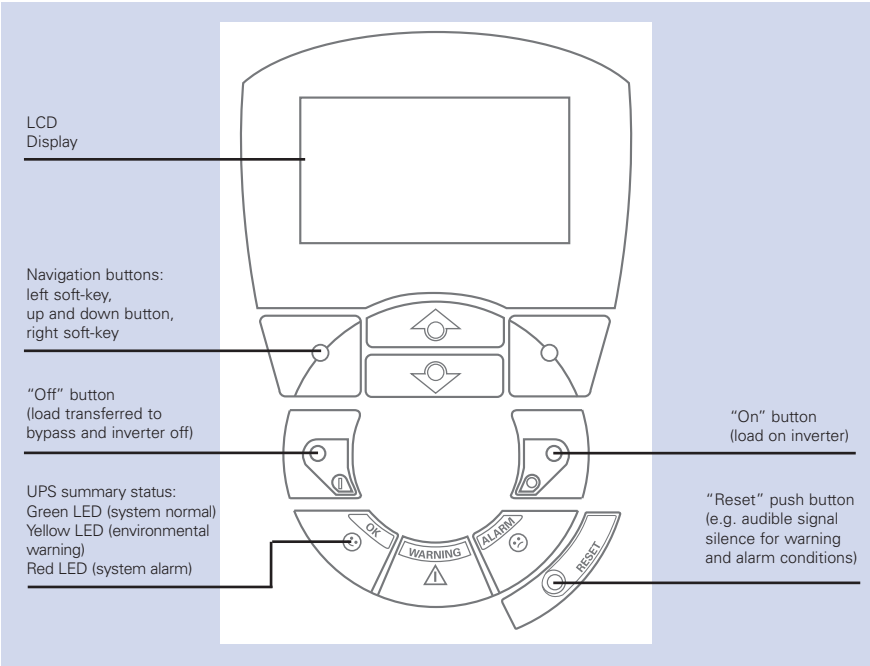


Figure 2. Control panel and LCD.

Default display page

The default page continuously displays a single-line diagram of the UPS (for reference see Figure 1). The main functional blocks and power paths of the UPS are displayed using simple universal technical symbols, making it possible to instantly understand the overall status of the UPS. On the same screen, the output load percentage measurement is permanently displayed, using three histograms (one for each output phase). In case the UPS is not in normal functioning mode, it is possible to access the "Warning and Alarm" summary page directly from the default page; warnings and alarms shall be identified by text strings and codes. In battery operation, the display shall switch between warning code and estimated backup time in minutes. After 30 seconds of inactivity (e.g. no buttons pressed) the display reverts to the default page.

5. Monitoring and Control Interfaces

Main Menus description
Using the navigation push buttons it is possible to access the following menus:

Measurements
From this menu it is possible to access the sub-menus, which display the measured values from each UPS functional block. Below is shown a subset of the available measurements related to the input/output power ports of the UPS:

Output (for each phase)		
Voltage	Current	Frequency
Active Power		Apparent Power
Input (for each phase)		
Voltage		Frequency
Bypass (for each phase)		
Voltage	Current	Frequency
Battery		
Voltage	Current (recharge and discharge)	

Battery Test
From this menu it is possible to set the battery test parameters or to initiate a manually requested test. Results of the test will be shown at the end of the procedure. See also 6.2.

UPS Parameters settings
From this menu it is possible to modify some settings related to input/output signals and functions of the UPS.

LCD Display settings
From this menu it is possible to select languages for the messages (languages available are English, Italian, German, French, Spanish and Portuguese) and the contrast of the LCD to allow regulation for optimal user visibility.

General Information
From this menu it is possible to access general information about the UPS (e.g. firmware revision, release date etc.).

5.3 Communication interfaces

5.3.1 Volt-free contact ports

Volt-free contacts shall be provided by Series C in accordance with the requirements of IBM AS/400 and other computer types. This interface shall be via a 9 pin D socket wired as follows:

Pin	Description	Function
1	BYPASS ACTIVE (normally closed)	Volt-free contact 'bypass operation'
2	LOW BATTERY (normally closed)	Volt-free contact 'battery discharged'
3	SUMMARY ALARM (normally closed)	Volt-free contact 'summary alarm'
4	MAINS FAILURE (normally closed)	Volt-free contact 'power failure'
5	COMMON	
6	BYPASS ACTIVE (normally open)	Volt-free contact 'bypass operation'
7	LOW BATTERY (normally open)	Volt-free contact 'battery discharged'
8	SUMMARY ALARM (normally open)	Volt-free contact 'summary alarm'
9	MAINS FAILURE (normally open)	Volt-free contact 'power failure'

The voltage-free contacts shall be rated at 24 V, 1 A.

5.3.2 Serial interface

Series C will be equipped with two serial ports. The interface shall be a D type connector with 9 pins for serial communication. The function of each pin shall be as follows:

Pin	Description	Function
1	Shield	Cable shield
2	TXD	Transmit RS232
3	RXD	Receive RS232
4	Not used	
5	Not used	
6	Not used	
7	Ground RS232	Signal ground for receiving and transmitting
8	Not used	
9	Not used	

Serial #1 (e.g. LIFE.net port); connector D type, 9 pins, male.

Pin	Description	Function
1	Ground	Shielding
2	TXD	Transmit RS232
3	RXD	Receive RS232
4	Not used	
5	Ground RS232	Signal ground for receiving and trans mitting
6	Not used	
7	RTS	Transmit enable RS232
8	Not used	
9	Not used	

Serial #2 (e.g. PPVis port); connector D type, 9 pins, female.

See section 10.13 for the details about connectivity applications that can be used with these ports.

5. Monitoring and Control Interfaces

5.4 E.P.O.

An Emergency Power Off (E.P.O.) contact shall be available on the unit. When this connection is open, with the inverter or static bypass supporting the load, the logic circuit will immediately power down the UPS output.

5.5 LIFE.net

In order to increase the overall reliability of the system, Series C will be compatible with LIFE.net communication kits, allowing connection to MASTERGUARD's LIFE.net diagnostic service. LIFE.net shall allow the remote diagnosis of the UPS through telephone lines or GSM link in order to ensure the maximum reliability of the UPS throughout its operational life.
The monitoring shall be a true 24 hour, 365 day service thanks to a unique feature that allows trained Service Engineers to remain in constant electronic contact with the service centre and therefore the UPS.
The UPS shall automatically telephone the service centre at defined intervals to provide detailed information that shall be analysed in order to predict near term problems. In addition, it shall be possible to control the UPS remotely. The transmission of UPS data to the MASTERGUARD Command Centre shall take place via the integrated modem at the following intervals:

- ROUTINE: settable between 5 minutes and 2 days (typically once a day)
- EMERGENCY: when a problem occurs or the parameters are outside the tolerance limits
- MANUAL: following the request of the command centre

During the call the command centre shall:

- Identify the UPS connected
- Request the data stored in the UPS memory during the time interval since the last connection
- Request real time information from the UPS (selectable)

The service centre shall analyse historical data and issue a regular detailed customer report informing him of the UPS operational condition and any critical conditions.
The LIFE.net centre allows the possibility to activate the option LIFE-SMS delivery system, where the customer can receive SMS notification should one of the following events be activated:

- Mains power failure
- Mains power recovered
- Reserve line failure
- Load supplied by reserve

6. Battery Management

Using Advanced Battery Care (ABC) Series C series shall preserve the design battery life. By following environmental recommendations given by battery manufacturers, ABC means batteries meet or exceed the declared design life. The main battery care features are described below.

6.1 Operating Parameters

When operating with maintenance free, valve regulated lead acid batteries (VRLA), the default parameters per cell shall be as follows:

- End of discharge voltage (V) 1.65
- Shutdown imminent alarm: Controlled by dedicated algorithm
- Nominal voltage (V) 2.0
- Battery discharging alarm (V) 2.20 @ 20°C
- Float voltage (V) 2.27 @ 20°C
- High voltage alarm (V) 2.4

6.2 Automatic Battery Test

The operating condition of the batteries shall be automatically tested by the control unit at selectable intervals, e.g. weekly, fortnightly or monthly. A short-time discharge of the battery will be made to confirm that all battery blocks and connecting elements are in good working order. In order to preclude a faulty diagnosis, the test will be launched, at the earliest, 24 hours after the last battery discharge. The battery test will be performed without any risk to the user, even if the battery is completely defective. A detected battery fault shall be alerted to the user. The battery test shall not cause any degradation in terms of expected life of the battery system. The automatic battery test parameters (e.g. activation, time interval etc.) shall be settable through the graphical LCD display (see section 5.2); also, it shall be possible to initiate a manual battery test using the same interface.

6.3 Ambient Temperature Compensated Battery Charger

The float voltage shall be automatically adjusted as a function of the temperature in the battery compartment (see technical tables for details) to maximise battery operating life.

6.4 Time Compensated End Of Discharge Voltage

When the discharge time becomes longer than 1 hour, the shutdown voltage shall be automatically increased, to avoid deep discharge to the battery due to a light load. The adjustment of the EOD voltage shall be controlled by a dedicated algorithm; it shall be also possible to modify the algorithm parameters using PPVis connectivity tool (see section 10.12).

7. Mechanical Data

7.1 Enclosure

The UPS shall be housed in a space-saving modular enclosure with front doors and removable panels (protection as standard to IP 21 for 10 - 40 kVA range, IP 20 for 50 - 60 kVA). The enclosure shall be made of zintec coated sheet steel. The doors shall be lockable.

7.2 Ventilation

Forced air cooling will ensure that all the components are operated within their specification. For 50 –60 kVA range, the cooling air entry shall be in the base and the air exit at the top of the device. The enclosure shall be installed with at least 400 mm of free space between device and ceiling at the top in order to allow an unhindered cooling air exit.

For 10 – 40 kVA range the cooling air entry shall be in the front panel and the air exit in the rear panel; clearance required in the rear of the unit shall be at least 100mm for ventilation reasons.

7.3 Cable entry

Cable entry shall be from the bottom or bottom-side of the cabinet. Top cable entry shall be available as standard for 50 - 60 kVA range (not valid for special versions).

7.4 Enclosure design

All the surfaces of the enclosure shall be finished with an electrostatically applied epoxy coat. The coating shall have a thickness of at least 60 microns. Standard colour of the enclosure shall be RAL 7035 (light grey).

7.5 Access to integrated subassemblies

For 50 - 60 kVA range, all internal subassemblies shall be accessible, for typical and most frequent maintenance, from the front of the unit via hinged doors. Rear access shall not be required for installation or servicing. The UPS shall be fork-liftable from the front after the removal of the bottom trim panel.
For 10 - 40 kVA range, the UPS will be movable on casters.

8. Technical Data (10 - 40 kVA range)

UPS Unit		Rating	10	15	20	30	40
8.1 Rectifier							
Nominal input voltage		(V)	400				
Input phases			3 Ph + N				
Input voltage tolerance	Full output load 75% output load	(%) (%)	-30/+15	-30/+15	-25/+15 -30/+15	-25/+15 -30/+15	-25/+15 -30/+15
Nominal frequency		(Hz)	50/60 [selectable]				
Frequency tolerance		(%)	±10%				
Maximum input power	Float Recharge	(kVA) (kVA)	9.3 11.2	13.9 15.8	18.5 20.4	27.8 30.3	37.0 42.1
Power factor @ nominal input voltage			>0.97				
Input current distortion at full load		(%)	<8				
Inrush current		(A)	$<I_{input\ max}$				
8.2 Battery charger							
Battery nominal voltage		(V)	288	288	288	384	384
Output voltage	Operating at 20°C	(V)	327	327	327	436	436
Battery float voltage temperature compensation		(V/°C %)	-3mV cell / °C				
Battery ripple current		(%)[1]	<5				
Output current		(A)	5	5	5	5	10
8.3 Inverter							
Nominal power rating @ 40°C		(kVA)	10	15	20	30	40
Nominal power rating @ 25°C		(kVA)	11	16.5	22	33	44
Nominal active power rating		(kW)	8	12	16	24	32
Power factor			0.8				
Overload	For 5 minutes For 30 seconds	(%) (%)	125 150				
Short-circuit current	300 % @ 50 Hz 150% @ 50 Hz	(ms) (s)	10 5				
Output voltage rating		(V)	400 [380/415 selectable]				
Output frequency		(Hz)	50/60				
Static output voltage stability for input AC voltage variations within limits and 100% load variations		(%)	±1				
Dynamic output voltage stability for 100% load variations		(%)	Complies with IEC/EN 62040-3, Class 1 (VFI, SS, 111)				
Phase angle precision with balanced loads		(degrees)	±1				
Phase angle precision with 100% unbalanced loads		(degrees)	±2				
Output frequency stability	With mains synchronism With internal quartz oscillator	(%) (%)	±2 [1, 3, 4 selectable] 0.1				
Frequency variation rate		(Hz/s)	<1 [0.1 to 2 selectable]				
Output voltage distortion	Linear full load Non-linear full load		<2% Complies with IEC/EN 62040-3				
Load peak factor without derating		(I_{pk}/I_{RMS})	3				
Neutral conductor sized up to			1.6 $I_{out\ nominal}$				
Automatic output power upgrading with temperature		@ 25°C (%) @ 30°C (%) @ 40°C (%)	110 105 100				

8. Technical Data (10 - 40 kVA range)

UPS Unit	Rating	10	15	20	30	40
8.4 Static switch						
Voltage rating	(V)	400 [380/415 selectable]				
Nominal frequency	(Hz)	50/60 [auto selection]				
Frequency tolerance	(%)	±2 [0.2 to 6 selectable]				
Voltage tolerance	(%)	±10 [5 to 15 selectable]				
Maximum overload capacity						
For 5 minutes	(%)	125				
For 30 seconds	(%)	150				
Bypass SCR characteristics						
I^2t @ T_{vj} =125°C	(A^2s)	18000				
I_{TSM} @ T_{vj} =125°C, 10ms	(A)	1900				
In-phase switching mode						
bypass/inverter	(ms)	Make Before Break (0ms)				
inverter/bypass	(ms)					
8.5 UPS data						
No load dissipated power	(W)	300	300	300	500	600
Maximum dissipated power						
Float	(W)	800	1200	1500	2350	3150
Recharge	(W)	1000	1400	1800	2550	3650
AC/AC efficiency digital interactive mode(2) 100% of load	(%)	98				
AC/AC efficiency double conversion mode(2) 100% of load	(%)	91				
Maximum noise level @ 1 metre (± 2 dBA)	(dBA)	<50	<50	<50	<52	<52
EMC class	EN 50091-2	Class A				
Degree of protection		IP 21				
Mechanical dimensions:						
Height	(mm)	1400	1400	1400	1600	1600
Width	(mm)	500	500	500	550	550
Depth	(mm)	800	800	800	800	800
Weight without integrated batteries	(kg)	145	145	145	190	210
Frame colour	(RAL scale)	7035				
Cooling		Forced				
Cable entry		Bottom/Side				
Equipment mobility		On casters				
8.6 Environmental						
Temperature:						
Operating	(°C)	0 - 40				
Max average daily (24 hrs)	(°C)	35				
Maximum (8 hrs)	(°C)	40				
Maximum relative humidity @ 20°C (not condensing)	(%)	90				
Elevation without derating (-1.2% Pn every 100m above 1000m up to 3000m)	(m)	1000				

8. Technical Data (10 - 40 kVA range)

UPS Unit	Rating	10	15	20	30	40
8.7 Battery						
Optimum battery temperature	(°C)(3)			20		
Power Output	(kW)	8.9	13.3	17.8	26.7	35.6
Recommended no. cells						
	VRLA	144	144	144	192	192
	Wet	144	144	144	192	192
	NiCd	225	225	225	300	300
End of discharge voltage	(V)	238	238	238	316	316
End of discharge current	(A)	37	56	75	84	113
Charging current	(A)	5	5	5	5	10

(1) <0.01 C_{10} for standard battery configuration.

(2) For tolerances see IEC/EN 60146-1-1 or DIN VDE 0558.

(3) The expected battery life is defined at 20°C. For every increment of 10° above 20°C the expected life is halved.

Note: The data shown are typical and are not specifically defined; furthermore the data refer to 25° C ambient temperature and PF = 1 where not specified. Not all data shown apply simultaneously and are subject to change without notice. If options described in chapter 10 are added, data shown in chapter 8 "Technical data (10 - 40 kVA range)" may be affected.

9. Technical Data (50 - 60 kVA range)

UPS Unit		Rating	50	60
9.1 Rectifier				
Nominal input voltage		(V)	400	
Input phases			3 Ph + N	
Input voltage tolerance	Full output load 75% output load	(%) (%)	-25/+15 -30/+15	
Nominal frequency		(Hz)	50/60 [selectable]	
Frequency tolerance		(%)	±10%	
Maximum input power	Float Recharge	(kVA) (kVA)	45.8 51.1	54.9 60.2
Power factor @ nominal input voltage			>0.97	
Input current distortion at full load		(%)	<25	
Inrush current		(A)	$<I_{input\ max}$	
9.2 Battery charger				
Battery nominal voltage		(V)	396	
Output voltage	Operating at 20°C	(V)	449	
Battery float voltage temperature compensation		(V/°C %)	-3mV cell / °C	
Battery ripple current		(%)[1]	<5	
Output current		(A)	10	
9.3 Inverter				
Nominal power rating @ 40°C		(kVA)	50	60
Nominal power rating @ 25°C		(kVA)	55	66
Nominal active power rating		(kW)	40	48
Power factor			0.8	
Overload	For 5 minutes For 30 seconds	(%) (%)	125 150	
Short-circuit current	300 % @ 50 Hz 150% @ 50 Hz	(ms) (s)	10 5	
Output voltage rating		(V)	400 [380/415 selectable]	
Output frequency		(Hz)	50/60	
Static output voltage stability for input AC voltage variations within limits and 100% load variations		(%)	±1	
Dynamic output voltage stability for 100% load variations		(%)	Complies with IEC/EN 62040-3, Class 1 (VFI, SS, 111)	
Phase angle precision with balanced loads		(degrees)	±1	
Phase angle precision with 100% unbalanced loads		(degrees)	±2	
Output frequency stability	With mains synchronism With internal quartz oscillator	(%) (%)	±2 [1, 3, 4 selectable] 0.1	
Frequency variation rate		(Hz/s)	<1 [0.1 to 2 selectable]	
Output voltage distortion	Linear full load Non-linear full load		<2% Complies with IEC/EN 62040-3	
Load peak factor without derating		(I_{pk}/I_{RMS})	3	
Neutral conductor sized up to			1.6 $I_{out\ nominal}$	
Automatic output power upgrading with temperature		@ 25°C (%) @ 30°C (%) @ 40°C (%)	110 105 100	

9. Technical Data (50 - 60 kVA range)

UPS Unit	Rating	50	60
9.4 Static switch			
Voltage rating	(V)	400 [380/415 selectable]	
Nominal frequency	(Hz)	50/60 [auto selection]	
Frequency tolerance	(%)	±2 [0.2 to 6 selectable]	
Voltage tolerance	(%)	±10 [5 to 15 selectable]	
Maximum overload capacity			
For 5 minutes	(%)	125	
For 30 seconds	(%)	150	
Bypass SCR characteristics			
I^2t @ T_{vj} =125°C	(A^2s)	80000	
I_{TSM} @ T_{vj} =125°C, 10ms	(A)	4000	
In-phase switching mode			
bypass/inverter	(ms)	Make Before Break (0ms)	
inverter/bypass	(ms)		
9.5 UPS data			
No load dissipated power	(W)	800	
Maximum dissipated power			
Float	(W)	3500	4150
Recharge	(W)	4000	4650
AC/AC efficiency digital interactive mode(2) 100% of load	(%)	98	
AC/AC efficiency double conversion mode(2) 100% of load	(%)	92	
Maximum noise level @ 1 metre (± 2 dBA)	(dBA)	<55	
EMC class	EN 50091-2	Class RS	
Degree of protection		IP 20	
Mechanical dimensions:			
Height	(mm)	1780	
Width	(mm)	620	
Depth	(mm)	835	
Weight without integrated batteries	(kg)	260	
Frame colour	(RAL scale)	7035	
Cooling		Forced	
Cable entry		Bottom/Side/Top	
Required service access		Front/Top	
9.6 Environmental			
Temperature:			
Operating	(°C)	0 - 40	
Max average daily (24 hrs)	(°C)	35	
Maximum (8 hrs)	(°C)	40	
Maximum relative humidity @ 20°C (not condensing)	(%)	90	
Elevation without derating (-1.2% Pn every 100m above 1000m up to 3000m)	(m)	1000	

9. Technical Data (50 - 60 kVA range)

UPS Unit	Rating	50	60
9.7 Battery			
Optimum battery temperature	(°C)(3)	20	
Power Output	(kW)	44.0	52.7
Recommended no. cells	VRLA Wet NiCd	198 198 300	
End of discharge voltage	(V)	327	
End of discharge current	(A)	134	161
Charging current	(A)	10	

(1) <0.01 C_{10} for standard battery configuration.

(2) For tolerances see IEC/EN 60146-1-1 or DIN VDE 0558.

(3) The expected battery life is defined at 20°C. For every increment of 10° above 20°C the expected life is halved.

Note: The data shown are typical and are not specifically defined; furthermore the data refer to 25° C ambient temperature and PF = 1 where not specified. Not all data shown apply simultaneously and are subject to change without notice. If options described in chapter 10 are added, data shown in chapter 9 "Technical data (50 - 60 kVA range)" may be affected.

10. Options

10.1 Remote alarm unit

A remote alarm panel shall be available to display individual important messages from UPS. Upon request, it shall be possible to connect up to 4 UPS systems to one alarm unit. The length of the connecting cable must not exceed 300 m.

10.2 Extended battery charger

It shall be possible to increase the UPS battery recharging capacity by adding one additional battery charger to the standard one. This additional board shall be housed inside the UPS cabinet.

10.3 Battery Management Modules (only upon request)

With measuring modules connected to the battery blocks, enhanced battery management shall be possible offering the following features:

- Measuring of the condition of each individual battery block by means of separate battery measuring modules (BMM)
- Analysis of each battery block through measuring of the minimum and maximum voltage values

10.4 External isolation transformer (only upon request)

This option shall be a double wound transformer housed in a special cubicle. Upon specific requirement, the transformer shall be provided with an electrostatic screen and/or with low inrush current. The option shall be used to isolate the UPS output from the load or the rectifier/reserve input from the mains AC input.

10.5 Dust filters

The option shall improve the protection degree of the air entrance from IP21 (IP20) to IP31 (IP30) for specific applications such as dusty environments. The filter shall be housed in the UPS cubicle (IP20/IP21).

10.6 Input low THDi option (50 - 60 kVA only)

Series C features active input harmonic reduction as standard in the 10 - 40 kVA range. For 50- 60 kVA UPS, a low input current distortion option shall be available, which shall reduce the THDi to less than 10%, without significantly affecting AC/AC efficiency. The option will be housed inside the UPS cubicle.

10.7 Empty battery cubicle

Matching empty battery cubicles shall be available and shall include the following:

- Cubicle
- Disconnecting device
- Fuses
- Safety screen
- Power terminal block

Three cubicle sizes shall be available:

	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
Type A	820	830	1780	220
Type A1	550	800	1600	100
Type A2	500	800	1400	90

10.8 Empty options cubicle (only upon request)

A special cubicle shall be available for customised applications such as:

- Input/Output voltage matching transformers
- Customised distribution boards
- Customised applications

10.9 Telephone switch for LIFE.net

The installation of this telephone switch for LIFE.net shall allow the customer to use a telephone line normally used for other purposes (fax or telephone).

10.10 MopUPS Shutdown and monitoring software

The main function of the MopUPS software shall be the safe shutdown of the operating system in the event of a power failure. Other functions include:

1. Automatic actions for events-email, messages, etc.
2. Recording of event log and status information on files
3. Viewing and monitoring of UPS in real time
4. Programmed system shutdown
5. Remote monitoring of UPS connected to network server using Named Pipes or TCP/IP

10.11 ManageUPS adapter

This option shall include a complete package (including hardware adapter, slot-in for 10 – 40 kVA range) to ensure monitoring and control of the networked UPS through TCP/IP protocol. The adapter permits:

- UPS monitoring from an NMS via SNMP
- UPS monitoring from PC via Web Browser
- Sending of e-mail messages on occurrence of events

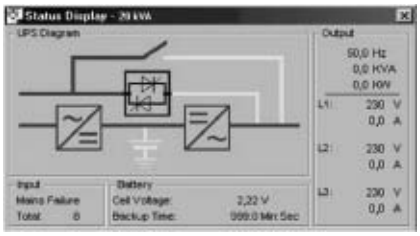
ManageUPS, in conjunction with MopUPS, shall also permit safe shutdown of the operating systems.

10. Options

10.12 PPVIS surveys Monitoring Software

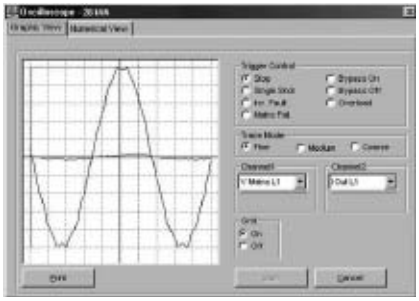
The survey images displayed below supply the user with essential information on the connected UPS:

State indication - power flux survey



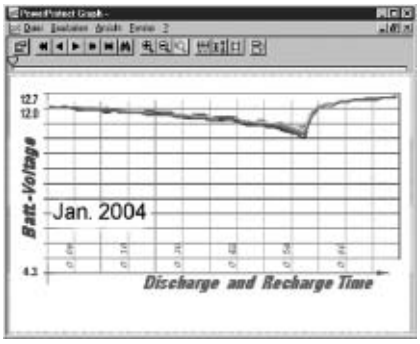
- Current state of components (UPS)
- Display of output voltage, UPS performance and load currents
- Number of power failures
- Battery cell voltage
- Available backup time

The oscilloscope - measuring of network or load conditions



- Dual-carrier measuring of the curves of input or output voltages or currents
- Flexible definable trigger conditions capable of being coupled onto the most different events, e.g. when a mains failure occurs

Battery display - Recognizing of parasitic effects in the early stages (for single block monitoring, BMM option is needed, see 10.3)



- Measuring of the condition of each individual battery block by means of separate battery measuring modules (BMM)
- Through mouse click: Analysis of each battery block with measuring of the minimum and maximum voltage values

10.13 Connectivity tables

The following table displays connectivity solutions which can be used in association with Series C. For further details, please refer to the MASTERGUARD Connectivity Solutions specifications.

Single Connectivity Solutions Table for Series C	
ManageUPSNET	Internal slot-in card(*) or external (box) network adapter (uses one serial port)
MopUPSPROFESSIONAL	Standard serial port (both can be used)
PPVis	Serial Port #1 and #2 can be used
LIFE.net	Only Serial Port #1 can be used

Simultaneous (up to 2) Connectivity Solutions Table for Series C			
Use the two different serial ports and/or the internal slot cards(*)			
	MangeUPSNET	**MopUPS**PROFESSIONAL	**LIFE.net**
ManageUPSNET	Yes	Yes	Yes
MopUPSPROFESSIONAL	Yes	Yes	Yes
LIFE.net	Yes	Yes	No
PPVis	Yes	Yes	Yes

(*) Only for 10 - 40 kVA range

11. Parallel Configuration

The Series C series of uninterruptible power systems shall have the capability to be connected in parallel for multi module configurations between units of the same rating. The maximum number of UPS in modular parallel configuration shall be 8. The load sharing shall be equal between the individual UPS systems, at any output load percentage.

The parallel connection of UPS shall increase redundancy (for reliability) and power.

Redundancy
If the installation requires more than one unit in redundant configuration, the power of each UPS should not be lower than $P_{tot}/(N-1)$ where:

P_{tot} = Total load power
N = Number of UPS units in parallel
1 = Minimum coefficient of redundancy

Under normal operating conditions, the power delivered to the load shall be shared between the number of UPS units connected to the parallel bus. In case of an overload the configuration is able to deliver P_{ov} x N without transferring the load onto the reserve, where:

P_{ov} = Max overload power of a single UPS
N = Number of UPS units in parallel

In the event of a failure of one of the UPS units, the faulty unit shall be disconnected from the parallel bus and the load shall be supplied from the remaining units without any break in supply continuity.

Power
It shall be possible to increase the power of the system using a non-redundant parallel configuration (redundancy coefficient = 0). In this case, all connected UPS units shall deliver the rated power, and in the event of a unit failure or overload the system shall transfer the load to reserve.

11.1 Modular parallel operations

The UPS systems of the Series C series shall be capable of operating in parallel modular configuration. For this purpose, UPS systems of the same rating shall be connected in parallel to form multi-module configurations. The parallel connection of UPS shall improve reliability or the total output power or both. When Series C is supplied with the parallel kit option, up to 8 equal UPS units can be operated in parallel for power upgrade or increase of redundancy. This option can also be added on at a later date in the field. It shall consist of one subassembly POB (Parallel Operation Board) and 25 pole, screened data lines to the neighbouring UPS modules. A multi-module system shall be controlled and monitored automatically by controlling the individual UPS systems (distributed control system). The communication bus which connects the paralleled units shall be arranged as a loop, allowing proper parallel operations even in the case of a single interruption occurring to this bus (first-failure proof bus). The reserve lines and inverters included in each UPS share the load, at any load percentage. See Figure 3 for details about the power connections.

11.1.1 System bypass switches

A system bypass switch shall be available as an option for the modular parallel configuration. This shall include two power disconnect switches. The ratings available shall be:

	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
160A	1400	440	840	190
400A	1780	620	858	300

Special SBS are needed for galvanically isolated special versions T and LAM (see Chapter 12).

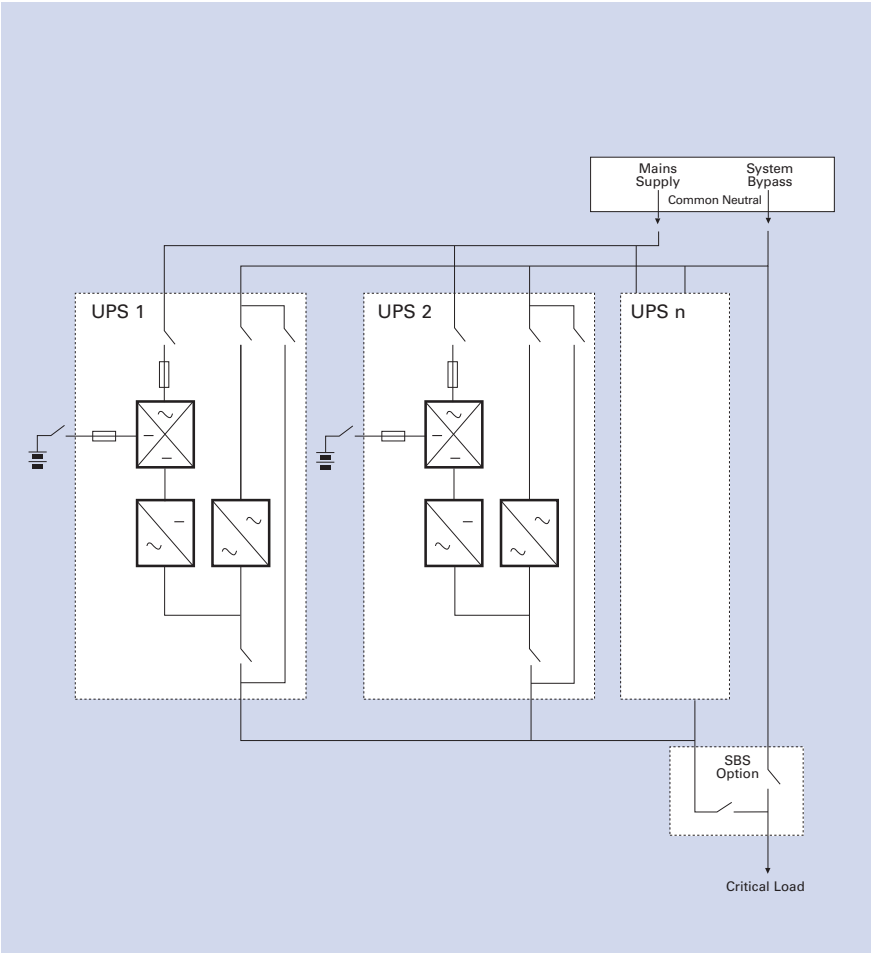


Figure 3.

12. Special Versions

Series C can be customised to achieve full galvanic isolation and voltage adaptation for specific load requirements. The following versions are available upon order:

12.1 T-version

Series C–T includes an internal isolation transformer on the input. This transformer is installed in the place of batteries (for 10 to 40 kVA) and allows full galvanic isolation between the load and the input mains utility. Technical data will change accordingly as indicated in the following table.

DESCRIPTION		**Unit**	**UPS power rating**						
		kVA	10	15	20	30	40	50	60
Electrical data									
INPUT	Voltage	Vrms	400V, 3Ø (+N), + 15%, (-30% with derating)						
	Current (single phase)	Arms	15	22	29	42	68	85	100
	Frequency	Hz	50/60 Hz auto selection						
OUTPUT	Power rating	kVA	10	15	20	30	40	50	60
		kW	8	12	16	24	32	40	48
	Voltage	Vrms	380, 400, 415V , 3Ø+N						
	Current @ 400 Vrms	Arms	14	22	29	43	58	72	87
	Frequency	Hz	50/60 Hz auto selection						
	Wave form	-	sinusoidal						
Max dissipation (@ nominal load and battery in recharge)		W	1200	1700	2200	3050	4850	6000	6750
Mechanical data									
Depth		mm	800					835	
Width		mm	500			550		620	
Height		mm	1400			1600		1780	
Weight		kg	280			380	460	560	
Max. noise level (@ 1m)		dBA	<55			<58		<58	

A further variation of T version, intended for electrically harsh environments, is also available. This version, called Series C-R, features TVSS (Transient Voltage Surge Suppressors) connected in parallel to the input transformer primary winding; these devices are housed within the UPS cubicle. For further information about the improved immunity grade of Series C–R to voltage surges, please contact MASTERGUARD Technical Support.

12. Special Versions

12.2 LAM-version

Series C – LAM includes two internal transformers for isolation and voltage adaptation from 400V to 208/220V phase to phase.

These transformers are installed in place of batteries (10-40 kVA): the one on the input (isolation transformer) allows full galvanic isolation and voltage adaptation (208/220 primary side, 400V secondary side), the one on the output (auto-transformer) allows voltage adaptation (400V primary side, 208/220V secondary side). Technical data will change accordingly to the following table.

DESCRIPTION		**Unit**	**UPS power rating**						
		kVA	10	15	20	30	40	50	60
Electrical data									
INPUT	Voltage	Vrms	208/220V, 3Ø (+N), + 15%, (-30% with derating)						
	Current (single phase)	Arms	33	50	66	99	132	165	198
	Frequency	Hz	60 Hz						
OUTPUT	Power rating	kVA	10	15	20	30	40	50	60
		kW	8	12	16	24	32	40	48
	Voltage	Vrms	208, 220V, 415V , 3Ø+N						
	Current @ 208 Vrms	Arms	28	42	56	84	111	139	167
	Frequency	Hz	60 Hz						
	Wave form	-	sinusoidal						
Max dissipation (@ nominal load and battery in recharge)		W	1450	2060	2650	3660	5820	7200	8100
Mechanical data									
Depth		mm	800					835	
Width		mm	500			550		620	
Height		mm	1400			1600		1780	
Weight		kg	350			470	583	720	
Max. noise level (@ 1m)		dBA	<55			<58		<58	

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